NASA SBIR/STTR Technologies

S1.08-9403 - Compact LIDAR for Aerosol Extinction Profiling from Small UAV's

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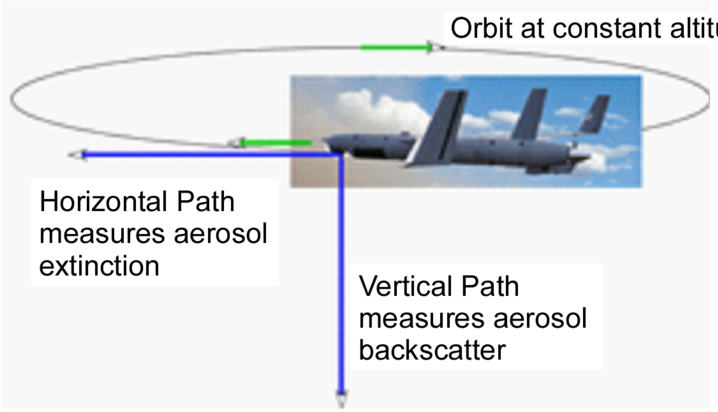
Identification and Significance of Innovation

In recognition of the Arctic as a bellwether for climate change, NASA has launched programs to increase observations there and incorporate findings into climate models. Monitoring aerosol distributions and their impact on radiative transfer is important in refining climate models. Given the difficulty of ground-based observations in the Arctic, instrumented UASs represent one means to efficiently monitor large areas. NASA's ARCTAS mission used manned aircraft and satellites to monitor trace gases and aerosols in the Arctic. Physical Sciences Inc. proposes to develop an elastic lidar capable of profiling aerosol extinction from a small UAS. Our design uses an innovative, compact Nd:YLF laser transmitter and High Density Interconnect electronics. We utilize the maneuverability of the UAS to determine extinction and backscatter coefficients by acquiring horizontal and nadir measurements at each altitude. This bypasses the assumptions used to retrieve aerosol extinction by elastic lidars.

Estimated TRL at beginning and end of contract: (Begin: 2 End: 3)

UAS Aerosol Lidar Operations Schematic



UAS orbit at constant altitude showing horizontal and vertical lidar retrievals

K-9334

Technical Objectives and Work Plan

The technical objectives of the Ph. I program are to:
- Create a sensor architecture that will provide the needed measurement performance.
- Demonstrate that the lidar design can be packaged into a volume consistent with the payload resources of the target UAS aircraft.
- Create a plan for the demonstration of the sensor payload.

To accomplish these objectives, the Ph. I Work Plan includes the following tasks:

1. Kickoff Meeting-Review program goals with NASA personnel including measurement metrics. Review candidate aircraft and downselect. Review opportunities for Ph. II demonstration.
2. Lidar design-Create a technical design for the backscatter lidar to determine the transmit power, receiver aperture dimension, range, and range resolution. Carry out an end-to-end signal analysis.
3. Payload engineering design-Create a mechanical design for the lidar so that it is consistent with the available payload resources of the target aircraft.
4. Payload-platform integration design-Create interface control documents describing interface between the payload and the aircraft power and communications buses.
5. Demonstration planning-Create a demonstration plan for Ph. II. Testing will include environmental testing in PSI's environmental chamber and flight demonstrations as determined in consultation with NASA personnel.

NASA Applications

The proposed lidar will enable measurements of aerosol optical extinction on a wider scale and at higher frequencies than are possible now. This is especially important in monitoring climate change in the Arctic as well as to NASA's climate change research efforts in general. One NASA program that might benefit is the GEO-CAPE mission. The sensor is suited to applications where sensor robustness and size are critical to performance, such as monitoring hazardous volcanic ash clouds.

Non-NASA Applications

Non-NASA commercial applications are likely to include many ground-based applications such as CBRNE detection, visibility and Asian dust monitoring, hazardous volcanic ash cloud monitoring, regional air quality and human health assessments. Introduction of the proposed lidar into newly emerging networks for boundary layer meteorology may also be possible.

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